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New national and regional Annex I Habitat records: from #123 to #138*

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Abstract

New Italian data on the distribution of some of the Annex I Habitats are reported in this contribution. Specifically, 16 records are presented including 9 new occurrences in Natura 2000 sites, and 27 new cells are added in the EEA 10 km × 10 km reference grid. The new data refer to the Italian administrative regions of Abruzzo, Apulia, Latium, Marche, Lombardy, Piedmont, Sardinia, Sicily, Tuscany, and Veneto.

Keywords

habitat, vegetation, 3140, 3150, 3170*, 3220, 4060, 5230*, 6220*, 6410, 6430, 6510, 7220*, 91AA*, 9540

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Introduction

This is the 11th contribution on this journal reporting on new occurrences of Annex I Habitats in Europe. By comparing the collected data with the results of the 4th Report ex-Art. 17 of Annex I Habitat Monitoring in Europe (Eionet 2019), these cell occurrences are newly recorded for Italy. The related phytosociological relevés for each contribution are reported and archived in the Italian database "VegItaly" (Gigante et al. 2012; Landucci et al. 2012).

Habitats records

Following the standard format proposed by Gigante et al. (2019), all species data, site data and descriptions are hereafter provided for each of the new records, from #123 to #138. We report a synthetic overview in Table 1. We used the open source QGIS Geographic Information System (QGIS.org 2020) for mapping purposes. Relevés and figures are provided as Suppl. materials 1, 2.

#123. Annex I Habitat: 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (Patera G)

EUNIS Classification system: C1 - Surface standing waters (EEA 2019).
Biogeographical Region: Continental.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Charion vulgaris* (Krause ex Krause et Lang 1977) Krause 1981, *Charetalia hispidae* Sauer ex Krausch 1964, *Charetea fragilis* F. Fukarek ex Krausch 1964 (Biondi and Blasi 2015; Mucina et al. 2016).
Geographic information: Italy, Lombardy, Crema, Ricengo, 85 m a.s.l., Coordinates: 45.406889°N, 9.718187°E (Suppl. material 1: table S1, Rel. 1).
Cell ID in the EEA reference grid: 10kmE429N247 (Suppl. material 2: fig. S1).
Natura 2000 Site Code: ZSC IT20A0003 "Palata Menasciutto".

Table 1. Synthetic overview of the newly reported data.

Hab ID	Hab name	Cell ID	Country	BR	N2000 Site	Authors
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	10kmE429N247,	Italy	CONT	IT20A0003	Patera G
		10kmE438N230,		MED,	IT5130007,	Fiaschi T, Fanfarillo E, Angiolini C
		10kmE437N233,		CONT,	IT5130001,	
		10kmE448N226,		CONT	-	Cannucci S, Fiaschi T, Mascia F
		10kmE446N218		MED	-	
3150	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation	10kmE447N219, 10kmE446N218, 10kmE446N219, 10kmE426N195, 10kmE427N197, 10kmE421N196	Italy	MED	-	Cannucci S, Mascia F, Angiolini C
3170*	Mediterranean temporary ponds	10kmE425N201	Italy	MED	ITB010007	Rivieccio G, Caria MC, Bagella S
3220	Alpine rivers and the herbaceous vegetation along their banks	10kmE411N248	Italy	ALP	IT1201000	Mainetti A, Ferrarato M, Lonati M
4060	Alpine and Boreal heaths	10kmE412N246, 10kmE411N246	Italy	ALP	-	Nota G, Marengo G, Lonati M
5230*	Arborescent matorral with *Laurus nobilis*	10kmE452N209	Italy	MED	-	Iamonico D, Di Pietro A
6220*	Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*	10kmE492N202	Italy	MED	-	Perrino EV
6410	*Molinia* meadows on calcareous, peaty or clayey-siltladen soils (*Molinion caeruleae*)	10kmE461N212,	Italy	MED	IT7110206,	Ciaschetti G, Venanzoni R
		10kmE459N215		ALP	IT7110128	
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	10kmE472N167	Italy	MED	-	Gianguzzi L, Rocca R
6510	Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)	10kmE443N249	Italy	CONT	-	Preo SM, Lorenzato L, Buffa G
7220*	Petrifying springs with tufa formation (*Cratoneurion*)	10kmE444N234,	Italy	CONT,	-	Fiaschi T, de Simone L, Angiolini C
		10kmE442N226,		MED,	IT5310019	
		10kmE447N221,		MED	IT5310017	Mei G, Stinca A
		10kmE453N227		CONT		
91AA*	*Quercus pubescens* forests	10kmE467N158	Italy	MED	-	Troia A, Brunco V, Bazan G
9540	Mediterranean pine forests with endemic Mesogean pines	10kmE439N230	Italy	MED	-	Bonari G, Candini F, Terranova G

Phytosociological table: Suppl. material 1: table S1; nomenclature and taxa delimitation according to Bazzichelli and Abdelahad (2009) and Portal to the Flora of Italy (2024).
Notes: The community dominated by *Chara vulgaris* grows spontaneously inside a waterproofed pond, restored for the conservation of *Rana latastei* Boulenger, 1879, an amphibian endemic to the Po Valley (Suppl. material 2: fig. S2). The restoration project was carried out in 2022, financed with funds from Life GESTIRE 2020.
This is the first reported site of occurrence of this habitat for the Serio River Regional Park and for the ZSC IT20A0003 "Palata Menasciutto".

#124. Annex I Habitat: 3140: Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (Fiaschi T, Fanfarillo E, Angiolini C)

EUNIS Classification system: C1 - Surface standing waters (EEA 2019).
Biogeographical Region: Mediterranean (Suppl. material 1: table S2, Rel. 1); Continental (Suppl. material 1: table S2, Rels. 2,3).
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Charetum vulgaris* Corillion 1957, *Charion vulgaris* (Krause ex Krause et Lang 1977) Krause 1981, *Charetalia hispidae* Sauer ex Krausch 1964, *Charetea intermediae* F. Fukarek 1961 (Biondi and Blasi 2015; Mucina et al. 2016).
Geographic information: Italy, Tuscany, Pistoia, Ponte Buggianese, 14 m a.s.l., Coordinates: 43.815469°N, 10.790413°E (Suppl. material 1: table S2, Rel. 1); Abetone Cutigliano, 1796 m a.s.l., Coordinates: 44.118933°N, 10.630688°E (Suppl. material 1: table S2, Rel. 2); Italy, Tuscany, Arezzo, Anghiari, 349 m a.s.l., Coordinates: 43.489651°N, 12.065598°E (Suppl. material 1: table S2, Rel. 3).
Cell ID in the EEA reference grid: 10kmE438N230 (Rel.1), 10kmE437N233 (Rel. 2), 10kmE448N226 (Rel. 3) (all the relevés refer to Suppl. material 1: table S2; Suppl. material 2: fig. S1).
Natura 2000 Site Code: ZSC IT5130007 "Padule di Fucecchio" (Rel. 1), ZSC IT5130001 "Alta valle del Sestaione" (Rel. 2), Currently not included in any Natura 2000 Site (Rel. 3). (all the relevés refer to Suppl. material 1: table S2).
Phytosociological table: Suppl. material 1: table S2; nomenclature and *taxa* delimitation according to Portal to the Flora of Italy (2024).
Notes: This habitat consists of ephemeral algal beds that form in neutral to alkaline freshwater environments (Mucina et al. 2016). Here, it was recorded in different environmental contexts, such as floodplain marshes (Suppl. material 1: table S2, Rel. 1), high mountain permanent natural lakes with oligotrophic waters (Suppl. material 1: table S2, Rel. 2), and artificial mesotrophic farmland ponds (Suppl. material 1: table S2, Rel. 3). Previous records of Habitat 3140 highlighted how it can develop also in peri-fluvial environments (Rivieccio et al. 2023, 2024).

#125. Annex I Habitat: 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (Cannucci S, Fiaschi T, Mascia F)

EUNIS Classification system: C1 - Surface standing waters (EEA 2019).
Biogeographical Region: Mediterranean.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Charion vulgaris* (W. Krause et Lang 1977) W. Krause 1981, *Charetalia intermediae* Sauer 1937, *Charetea intermediae* F. Fukarek 1961 (FloraVeg.EU 2024)
Geographic information: Italy, Tuscany, Grosseto, Sorano, 392 m a.s.l., Coordinates: 42.765243°N, 11.74231°E (Suppl. material 1: table S3, Rel. 1); Grosseto, Sorano, 436 m a.s.l., Coordinates: 42.764914°N, 11.745769°E (Suppl. material 1: table S3, Rel. 2).
Cell ID in the EEA reference grid: 10kmE446N218 (Suppl. material 2: fig. S1).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table S3; vascular *taxa* nomenclature according to Portal to the Flora of Italy (2024); algal *taxa* nomenclature according to Bazzichelli and Abdelahad (2009).
Notes: This habitat is characterized by algal beds thriving in freshwater with neutral to alkaline pH levels, attributable to the alliance *Charion vulgaris* (Mucina et al. 2016). Similar communities have been identified recently in central-southern Tuscany and are likewise classified under habitat type 3140 (Rivieccio et al. 2024).

#126. Annex I Habitat: 3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*- type vegetation (Cannucci S, Mascia F, Angiolini C)

EUNIS Classification system: C1 - Surface standing waters (EEA 2019).
Biogeographical Region: Mediterranean.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Potamogetonion* Libbert 1931, *Potamogetonetalia* Koch 1926, *Potamogetonetea* Klika in Klika et Novák 1941 (FloraVeg.EU 2024).

Geographic information: Italy, Latium, Acquapendente, 507 m a.s.l., Coordinates: 42.810629°N, 11.83453°E (Rel. 1); Italy, Latium, Proceno, 360 m a.s.l., Coordinates: 42.786451°N, 11.75104°E (Rel. 2); Italy, Tuscany, Radicofani, 415 m a.s.l., Coordinates: 42.8593793°N, 11.7583034°E (Rel. 3); Italy, Sardinia, Alà dei Sardi, 594 m a.s.l., Coordinates: 40.658543°N, 9.357416°E (Rel. 4); Olbia, 27 m a.s.l., Coordinates: 40.916202°N, 9.457005°E (Rel. 5); Nulvi, 474 m a.s.l., Coordinates: 40.818659°N, 8.786293°E (Rel. 6; all the relevés refer to Suppl. material 1: table S4).
Cell ID in the EEA reference grid: 10kmE447N219 (Rel. 1), 10kmE446N218 (Rel. 2), 10kmE446N219 (Rel. 3), 10kmE426N195 (Rel. 4), 10kmE427N197 (Rel. 5), 10kmE421N196 (Rel. 6; all the relevés refer to Suppl. material 1: table S4; Suppl. material 2: fig. S3).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table S4; nomenclature and taxa delimitation according to Portal to the Flora of Italy (2024).
Notes: The habitat has been found in permanent ponds, in semi-natural contexts linked to traditional agro-zootechnical landscape of three (one insular, two continental) Italian administrative regions, at elevations varying from 20 m up to 594 m a.s.l. The investigated habitat, even if inserted in a semi-natural territorial matrix, hosts rare taxa and species of local conservation concern (*Najas major* for Tuscany, *Ceratophyllum submersum* subsp. *submersum* and *Utricularia australis* for Sardinia).

#127. Annex I Habitat: 3170* Mediterranean temporary ponds (Rivieccio G, Caria MC, Bagella S)

EUNIS Classification system: C3.4 - Species-poor beds of low-growing water-fringing or amphibious vegetation (EEA 2019).
Biogeographical Region: Mediterranean.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Romuleo requienii-Isoëtetum histricis* Bagella et al. 2009, *Isoëtion* Br.-Bl. 1936, *Isoëtetalia* Br.-Bl. 1935, *Isoëto-Nanojuncetea* Br.-Bl. et Tx. in Br.-Bl. et al. 1952 (Mucina et al. 2016).
Geographic information: Italy, Sardinia, Sassari, Santa Teresa di Gallura, Capo Testa, 48 m a.s.l., Coordinates: 41.2646404°N, 9.182032°E (Suppl. material 1: table S5, Rel. 1).
Cell ID in the EEA reference grid: 10kmE425N201 (Suppl. material 2: fig. S4).
Natura 2000 Site Code: SIC ITB010007 "Capo Testa".
Phytosociological table: Suppl. material 1: table S5; nomenclature and taxa delimitation according to Portal to the Flora of Italy (2024).
Notes: In Capo Testa, this habitat is in mosaic with H6220* "Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*". It is usually localized in small waterlogged depressions that are already drying up at the beginning of spring. The plant communities, characterized by *Isoëtes histrix* and the small endemic geophytes *Romulea requienii*, can be referred to the association *Romuleo requienii-Isoëtetum histricis* described in Bagella et al. (2009).
The sensitivity of these ephemeral wetland swards calls for necessary conservation measures (Bagella and Caria 2013). Recently, the presence of *Isoëtes histrix* has also been reported by iNaturalist (2024) for the Faro of Capo Testa, suggesting that the H3170* should be present in other parts of the Natura 2000 Site and the importance of citizen science in assessing species and habitat distribution.

#128. Annex I Habitat: 3220 Alpine rivers and the herbaceous vegetation along their banks (Mainetti A, Ferrarato M, Lonati M)

EUNIS Classification system: U71 - Unvegetated or sparsely vegetated shore with mobile sediments in montane and alpine regions (EEA 2021).
Biogeographical Region: Alpine.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Epilobion fleischeri* G. Br.-Bl. ex Br.-Bl. 1950, *Epilobietalia fleischeri* Moor 1958, *Thlaspietea rotundifolii* Br.-Bl. 1948 (Mucina et al. 2016).
Geographic information: Italy, Piedmont, Noasca, Loc. vallone di Noaschetta Betasse, 1630 m a.s.l., Coordinates: 45.468972°N, 7.326413°E (Suppl. material 1: table S6, Rels. 1,2); Loc. vallone di Noaschetta Pian Sengio, 1490 m a.s.l., Coordinates: 45.463223°N, 7.321041°E (Suppl. material 1: table S4, Rels. 3,4).
Cell ID in the EEA reference grid: 10kmE411N248 (Suppl. material 2: fig. S5).
Natura 2000 Site Code: SAC/SPA IT1201000 "Parco Nazionale del Gran Paradiso".
Phytosociological table: Suppl. material 1: table S6; vascular *taxa* nomenclature according to Portal to the Flora of Italy (2024); algal *taxa* nomenclature according to Bazzichelli and Abdelahad (2009).
Notes: Gravel banks of the *Epilobion fleischeri* are quite frequent in the Alpine biogeographical region and in the Western Alps, although the naturalness of Alpine rivers has been generally compromised over the years. In the SAC/SPA IT1201000 'Parco Nazionale Gran Paradiso' the habitat code 3220 is known for many cells but not the one reported here. The Noaschetta mountain streams actually have limited areas colonised by this habitat due to existing dams.

#129. Annex I Habitat: 4060 Alpine and Boreal heaths (Nota G, Marengo G, Lonati M)

EUNIS Classification system: S227 - Alpine *Rhododendron hirsutum - Erica* heaths (EEA 2021).
Biogeographical Region: Alpine.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Ericion carneae* Rübel ex Grabherr, Greimler et Mucina in Grabherr et Mucina 1993, *Rhododendro ferruginei-Vaccinietalia microphylli* Br.-Bl. in Br.-Bl. et Jenny 1926, *Loiseleurio procumbentis-Vaccinietea microphylli* Eggler ex Schubert 1960 (Biondi and Blasi 2015).
Geographic information: Italy, Piedmont, Germagnano (TO), Monte Turu, 1252 m as.l., Coordinates: 45.235725°N, 7.464328°E (Rel. 1); Monte Turu, 1266 m as.l., Coordinates: 45.235664°N, 7.465158°E (Rel. 2); Viù (TO), Loc. Mombas, 1003 m as.l., Coordinates: 45.230374°N, 7.457364°E (Rel. 3); Loc. Mombas, 995 m as.l., Coordinates: 45.231039°N, 7.457333°E (Rel. 4); Loc. Arbarai, 802 m as.l., Coordinates: 45.230454°N, 7.441304°E (Rel. 5; all the relevés refer to Suppl. material 1: table S7).
Cell ID in the EEA reference grid: 10kmE412N246 (Suppl. material 1: table S7, Rels. 1–4); 10kmE411N246 (Suppl. material 1: table S7, Rel. 5) (Suppl. material 2: fig. S6).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table S7; nomenclature and *taxa* delimitation according to Portal to the Flora of Italy (2024).
Notes: *Erica carnea* grows here at the western limits of its alpine distribution range (Meusel et al. 1978), forming low-elevation sub-acidophilus heaths on serpentine rocks belonging to the *Ericion carneae* Rübel ex Grabherr, Greimler et Mucina in Grabherr et Mucina 1993 alliance. Because of the serpentine substrate, both basophilous (e.g., *Sesleria caerulea*, *Daphne cneorum*, *Teucrium montanum*) and acidophilous (e.g., *Calluna vulgaris*) species can be found (Suppl. material 1: table S7). This alliance, which includes the association *Ericetum carneae* Rübel 1911, is ranked by Mucina et al. (2016) within the order *Rhododendro hirsuti-Ericetalia carneae* Grabherr et al. 1993, class *Rhododendro hirsuti-Ericetea carneae* Schubert et al. 2001; however, other authors (Biondi and Blasi 2015; Theurillat et al. 1995) include the same alliance in the order *Rhododendro ferruginei-Vaccinietalia microphylli* Br.- Bl. in Br.-Bl. et Jenny 1926, class *Loiseleurio procumbentis-Vaccinietea microphylli* Eggler ex Schubert 1960. Here, the second phytosociological attribution was more appropriate, for the following reasons: (i) in the western Alps, many characteristic and transgressive species of the order *Rhododendro hirsuti-Ericetalia* (e.g., *Daphne striata*, *Rhodothamnus chamaecistus*, *Rhododendron hirsutum*) are absent for biogeographical reasons, (ii) the recorded communities include acidophilus species characteristic of the order *Vaccinietalia* (and subordinate units). Given the peculiar plant composition of these formations, further phytosociological investigations are necessary to assess their possible attribution to a different association than the *Ericetum carneae*.

#130. Annex I Habitat: 5230* Arborescent matorral with *Laurus nobilis* (Iamonico D, Di Pietro A)

EUNIS Classification system: T22 - Mainland laurophyllous forest (EEA 2021).
Biogeographical Region: Mediterranean.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Asparago acutifolii-Laurion nobilis* Gianguzzi, Cuttonaro, Cusimano et Romano 2016, *Quercetalia ilicis* Br.-Bl. ex Molinier 1934, *Quercetea ilicis* Br.-Bl. ex A. Bolòs et O. de Bolòs in A. Bolòs et Vayreda 1950 (Gianguzzi et al. 2016; Mucina et al. 2016).
Geographic information: Italy, Latium, Rome Municipality, Pineto Urban Park, 120 m a.s.l., Coordinates: 41.931389°N, 12.441389°E (Suppl. material 1: table S8, Rel. 1); *ibidem*, 121 m a.s.l., Coordinates: 41.931531°N, 12.441439°E (Suppl. material 1: table S8, Rel. 2).
Cell ID in the EEA reference grid: 10kmE452N209 (Suppl. material 2: fig. S7).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table S8; nomenclature and *taxa* delimitation according to Portal to the Flora of Italy (2024).
Notes: This vegetation type has a fragmentary and circumscribed distribution in Italy and shows a relictual character (Brullo et al. 2001). According to Filibeck (2009), the communities of the arborescent matorrals with *Laurus nobilis* occurring in Mediterranean contexts (as the Pineto Urban Park), refers to the type "laurel-dominated gallery forests ... by tree of *Laurus nobilis*, in ravines and secondary valleys" (translation from the Italian by the authors). In fact, in addition to the floristic composition (*Laurus nobilis* dominating *plus* few other woody species, such as *Quercus ilex* L., *Quercus pubescens* Willd. and *Viburnum tinus* L. subsp. *tinus*) and the habit of bay laurel (arboreal, up to 15 m tall and with trunks more than 30 cm on average in diameter, up to 40 cm), the community found in Rome is clearly linked to the local topographic features (a small valley about 40 m long and 10 m deep) which, in turn, causes the local climatic condition (e.g., high humidity and very low or not aridity). Despite the vegetation found is species-poor, its composition and structure is clearly identifiable as the habitat 5230* according to Filibeck (2009).
The detected habitat occupies a reduced area, but, according to Filibeck (2009) these types are rapresented by "... communities which mostly occupy reduced areas; in fact, laurel becomes dominant where only where topographic or soil characteristics mitigate both summer aridity and winter frosts …" (translation from the Italian by the authors).

It was expected to be affected by degradation due to human pressures, due to the surrounding landscape which is characterized mostly by urbanized matrix (especially toward east). Human impact is considered one of the factors that might have contributed to limit the area occupied by the native laurophylls in Italy (Alessi et al. 2019).
Robinia pseudoacacia L. is an alien invasive for Italy and Europe (see e.g., Celesti-Grapow et al. 2013; Iamonico 2022). However, it is to be noted that the forest found in Pineto Urban Park is characterized by a two-layeread-tree vertical structure. Plants of black locust occupy the upmost layer of the forest (an emergent layer of deciduous trees) being at least 20 m tall, whereas laurel individuals form a canopy layer of evergreen trees, reaching to 15 m high. *R. pseudoacacia* might affect the abundance of *L. nobilis* due to the occurrence of seedlings of black locust in the shrub layer. From the syntaxonomic point of view, we here follow Gianguzzi et al. (2016). To be noted, however, that Biondi et al. (2014) considered the priority habitat 5230* as referred to the alliance *Fraxino orni-Quercion ilicis* Biondi, Casavecchia et Gigante ex Biondi, Casavecchia et Gigante in Biondi, Allegrezza, Casavecchia, Galdenzi, Gigante et Pesaresi 2013.

#131. Annex I Habitat: 6220* Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea* (Perrino EV)

EUNIS Classification system: R1F - Mediterranean annual-rich dry grassland (EEA 2021).
Biogeographical Region: Mediterranean.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Stipion retortae* O. de Bolòs 1957, *Brachypodietalia distachyi* Rivas-Martínez 1978, *Stipo-Trachynietea distachyae* S. Brullo in S. Brullo et al. 2001 (Mucina et al. 2016)
Geographic information: Italy, Apulia, Bari, Polignano a Mare, Costa Ripagnola, 9 m a.s.l., Coordinates: 41.032832°N, 17.151004°E (Suppl. material 1: table S9, Rel. 1); Italy, Bari, Polignano a Mare, Costa Ripagnola, 8 m a.s.l., Coordinates: 41.032992°N, 17.150252°E (Suppl. material 1: table S9, Rel. 2).
Cell IDs in the EEA reference grid: 10kmE492N202 (Suppl. material 2: fig. S8).
Natura 2000 Site Code: Currently not included any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table S9; nomenclature and *taxa* delimitation according to Portal to the Flora of Italy (2024).
Notes: In the study area, along the rocky coast, located north of the SS16 road, it is possible to observe extensive evergreen shrub vegetation with annual clearings with *Stipellula capensis* (Suppl. material 2: fig. S9). The flora of this coastal area has already been studied in the past by other authors (Perrino et al. 2013a, 2013b), while reports of plant communities are very rare and not complete (Perrino and Signorile 2012). About the flora, it is worth to note that, in the same place, grows *Ophioglossum lusitanicum* (Perrino et al. 2013a, 2013b), a small fernlike plant, already studied in Italy at plant community level (Perrino et al. 2022).

#132. Annex I Habitat: 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) (Ciaschetti G, Venanzoni R)

EUNIS Classification system: R37 - Temperate and boreal moist or wet oligotrophic grassland (EEA 2021).
Biogeographical Region: Mediterranean (Suppl. material 1: table S10, Rel. 1); Alpine (Suppl. material 1: table S10, Rel 2).
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Molinion caeruleae* Koch 1926, *Molinietalia caeruleae* Koch 1926, *Molinio-Arrhenatheretea* Tx. 1937 (Biondi and Blasi 2015).
Geographic information: Italy, Abruzzo, L'Aquila, Rocca di Mezzo, Campo di Rovere, 1300 m a.s.l., Coordinates: 42.18301°N, 13.52597°E (Suppl. material 1: table S10, Rel. 1); Italy, Abruzzo, L'Aquila, Pizzoli, Vomano springs, 1160 m a.s.l., Coordinates: 42.485365°N, 13.367151°E (Suppl. material 1: table S10, Rel. 2).
Cell IDs in the EEA reference grid: 10kmE461N212 (Suppl. material 1: table S10, Rel. 1); 10kmE459N215 (Suppl. material 1: table S10, Rel. 2) (Suppl. material 2: fig. S10).
Natura 2000 Site Codes: SAC IT7110206 "Monte Sirente e Monte Velino" (Suppl. material 1: table S10, Rel. 1); ZPS IT7110128 "Parco Nazionale Gran Sasso - Monti della Laga" (Suppl. material 1: table S10, Rel. 2).
Phytosociological table: Suppl. material 1: table S10; taxonomic nomenclature of plants according to Bartolucci et al. (2018).
Notes: The habitat is new in Central Italy.

#133. Annex I Habitat: 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (Gianguzzi L, Rocca R)

EUNIS Classification system: R56 - Montane to subalpine moist or wet tall-herb and fern fringe (EEA 2021).
Biogeographical Region: Mediterranean.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Petagnietum saniculifoliae* Brullo et Grillo 1978, *Fragarion vescae* Tx. ex von Rochow 1951, *Circaeo lutetianae-Stachyetalia sylvaticae* Passarge 1967, *Epilobietea angustifolii* Tx. et Preising ex von Rochow 1951 (Mucina et al. 2016).

Geographic information: Italy, Sicily, Ucria, Vallone sul versante W di Monte Cuculone, 950 m a.s.l., Coordinates: 38.0298040°N, 14.5838215°E (Suppl. material 1: table S11, Rel. 1).
Cell ID in the EEA reference grid: 10kmE472N167 (Suppl. material 2: fig. S11).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table 11; nomenclature and *taxa* delimitation according to Portal to the Flora of Italy (2024).
Notes: *Petagnaea gussonei* (Apiaceae) is one of the Sicilian vascular species listed in the Annexes II and IV of the Habitats Directive; it is also included in the Annex I of the Bern convention (1979) in "The top 50 Mediterranean Island Plants" (Gianguzzi and La Mantia 2005) and in regional and national red lists (Gianguzzi 2011). This species constitutes a relevant macro-endemism, (De Castro et al. 2013, 2015a, 2015b; Brullo and Brullo 2020), having survived in localized refuge sites in a circumscribed area of the Nebrodi Mts. (North-East Sicily) (Gianguzzi and La Mantia 2004), where it grows on the edges of hill and sub-mountain streams. A monitoring activity in its native territory led to the location of 21 residual subpopulations (Gianguzzi and La Mantia 2004; Gianguzzi et al. 2004; Gianguzzi and La Mantia 2005). These aspects of vegetation have been phytosociologically ascribed to the *Petagnietum saniculifoliae* association (Brullo and Grillo 1978; Gianguzzi et al. 2004) and referred to habitat 6430 ("Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels").The station in question is the easternmost known so far for this association; it is located on the western slope of Pizzo Cuculone (Ucria), where it colonizes a small tributary of the Torrente Pudarà (De Castro et al. 2007), at elevations between 800 and 1000 m a.s.l. The valley is fed by a rich spring and flows incised through flysch soils, in the lower subhumid Mesomediterranean bioclimatic belt. The plant landscape is largely dominated by hazel groves, occasionally interrupted by small woodland clusters of *Quercus pubescens* Willd. s.l. or *Castanea sativa* Mill. (on deep soils), or *Ostrya carpinifolia* Scop. (on lithoid outcrops). The habitat develops along the margins of the small stream, characterized by the presence of *Petagnaea gussonei* (Suppl. material 2: fig. S12) and other characteristic species (such as *Angelica sylvestris*, *Chaerophyllum temulum*, *Stachys sylvatica*, *Lamium flexuosum*, *Lysimachia nemorum*, *Circaea lutetiana*, etc.), as well as a rich bryophyte-pteridophyte component (*Polystichum setiferum*, *Lophiolepis vallis-demonii*, *Polypodium cambricum*, etc.). However, the conservation status of the habitat is to be considered at risk; the main threats are represented by the isolation and fragmentation of the hygrophilous vegetation (Capotorti et al. 2020), but also by the depletion of water resources, both due to ongoing climate change and anthropogenic factors (given possible water extraction upstream).

#134. Annex I Habitat: 6510 Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) (Preo SM, Lorenzato L, Buffa G)

EUNIS Classification system: R22 – Low and medium altitude hay meadows (EEA 2021).
Biogeographical Region: Continental.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Centaureo-Arrenatheretum elatioris* Oberd. 1964 corr. Poldini et Oriolo 1994, *Arrhenatherion elatioris* Koch 1926, *Arrhenatheretalia elatioris* Tx. 1931, *Molinio-Arrhenatheretea* Tx. 1937 (Biondi et al. 2014; Mucina et al. 2016).
Geographic information: Italy, Veneto, Vicenza, 40 m a.s.l., Coordinates: 45.575820°N, 11.511889°E (Suppl. material 1: table S12, Rel. 1).
Cell ID in the EEA reference grid: 10kmE443N249 (Suppl. material 2: fig. S13).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table 12; nomenclature and *taxa* delimitation according to Bartolucci et al. (2018).
Notes: The site is a semi-natural lowland mesic meadow located in the northern part of the municipality of Vicenza. It is situated within a heterogeneous landscape comprising semi-natural lands, cultivated fields, and urban areas. The meadow has an approximate surface area of 3.5 hectares and has undergone improvements as part of a LIFE project (LIFE19 NAT/IT/000848 LIFE PollinAction). Specifically, the existing meadow has been enhanced through the introduction of entomophilous native species (i.e., *Centaurea nigrescens* Willd. subsp. *nigrescens*, *Achillea roseoalba* Ehrend., *Salvia pratensis* L. subsp. *pratensis*, *Malva alcea* L.) produced in a nursery and transplanted in the field in autumn 2022. These improving operations have facilitated a gradual evolution of the site towards habitat type 6510. The maintenance of the meadow is facilitated by the implementation of traditional management practices by local farmer. These include the mowing and hay harvesting of the meadow twice a year, in June and September. Despite the occurrence of some ruderal species with low coverage (which nevertheless are a constant feature of lowland meadows), based on the species composition, the meadow can be ascribed to *Centaureo-Arrenatheretum elatioris* Oberd. 1964 corr. Poldini et Oriolo 1994 due to the presence of species such as *Centaurea nigrescens* and *Achillea roseo-alba*, differential species of the association. This meadow type has been extensively studied in north-eastern Italy, and appropriate syntaxonomic reference to describe habitat 6510 were reported (e.g., Poldini and Oriolo 1994; Buffa et al. 1995; Scotton et al. 2012; Tasinazzo 2014).

#135. Annex I Habitat: 7220* Petrifying springs with tufa formation (*Cratoneurion*) (Fiaschi T, de Simone L, Angiolini C)

EUNIS Classification system: C2.121 - Petrifying springs with tufa or travertine formations (EEA 2019).
Biogeographical Region: Continental (Suppl. material 1: table S13, Rel. 1); Mediterranean (Suppl. material 1: table S13, Rels. 2, 3).
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Cratoneurion commutati* Koch 1928, *Montio-Cardaminetalia* Pawłowski et al. 1928, *Montio-Cardaminetea* Br.-Bl. et Tx. ex Klika et Hadac 1944 (Mucina et al. 2016).
Geographic information: Italy, Tuscany, Firenze, Firenzuola, 255 m a.s.l., Coordinates: 44.175318°N, 11.48561°E (Suppl. material 1: table S13, Rel 1); Italy, Tuscany, Siena, Castellina in Chianti, 399 m a.s.l., Coordinates: 43.500653°N, 11.276816°E (Suppl. material 1: table S13, Rel 2); Italy, Tuscany, Siena, Sarteano, 415 m a.s.l., Coordinates: 42.987573°N, 11.887661°E (Suppl. material 1: table S13, Rel 3).
Cell ID in the EEA reference grid: 10kmE444N234 (Rel 1), 10kmE442N226 (Rel 2), 10kmE447N221 (Rel 3) (all the relevés refer to Suppl. material 1: table S13; Suppl. material 2: fig. S14).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table S13; taxonomic nomenclature for vascular species in accordance with the Portal to the Flora of Italy (2024), for bryophytes with Aleffi et al. (2023).
Notes: Dripping walls with water trickling all year round; all 7220* survey sites are located near rivers and streams. *Palustriella commutata* is a typical indicator species and very frequently occurs in habitat 7220* Petrifying springs with tufa formation. However, the habitat does not necessarily require the presence of *P. commutata* for its identification. In fact, some authors consider also surveys without *P. commutata* as still attributable to habitat 7220*, based on other diagnostic features or the composition of the observed plant communities (Couvreur et al. 2016; Hugonnot et al. 2017). Although the presence of *P. commutata* can strengthen the identification of habitat 7220*, it is not a mandatory condition. If other key or indicative species are present, along with appropriate abiotic conditions (e.g., calcareous waters and active travertine formation), the habitat can still be confirmed in its absence. Therefore, in our surveys, the occasional absence of *P. commutata* does not compromise the identification of habitat 7220*.

#136. Annex I Habitat: 7220* Petrifying springs with tufa formation (*Cratoneurion*) (Mei G, Stinca A)

EUNIS Classification system: C2.121 - Petrifying springs with tufa or travertine formations (EEA 2019).
Biogeographical Region: Continental.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Cratoneurion commutati* Koch 1928, *Montio-Cardaminetalia* Pawłowski et al. 1928, *Montio-Cardaminetea* Br.-Bl. et Tx. ex Klika et Hadac 1944 (Mucina et al. 2016).
Geographic information: Italy, Marche, Pesaro e Urbino, Cagli, loc. Case san Pietro, 280 m a.s.l. Coordinates: 43.541021°N, 12.652634°E (Rel 1); 319 m a.s.l., Coordinates: 43.540000°N, 12.654820°E (Rel 2); Monte Bambino, 534 m a.s.l. Coordinates: 43.530918°N, 12.657798°E (Rel 3); 554 m a.s.l., Coordinates: 43.529239°N, 12.658769°E (Rel 4); cascata, 588 m a.s.l., Coordinates: 43.527938°N, 12.660515°E (Rel 5); Fiume Bosso – Tre pozzi, 265 m a.s.l., Coordinates: 43.539391°N, 12.637545°E (Rel 6); Fiume Bosso – Il Canyon, 280 m a.s.l., Coordinates: 43.542426°N, 12.629136°E (Rel 7); Fiume bosso – Cascata del Molino di Secchiano, 295 m a.s.l., Coordinates 43.549886°N, 12.617392°E (Rel 8); Fosso di Terie, 410 m a.s.l., Coordinates: 43.521861°N, 12.590902°E (Rels. 9, 10) (all the relevés refer to Suppl. material 1: table S14).
Cell ID in the EEA reference grid: 10kmE453N227 (Suppl. material 2: fig. S14).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site (Rels. 1, 2, 9, 10), IT5310019 "Monte Catria, Monte Acuto" (Rels. 3, 4, 5), IT5310017 "Monte Nerone - Gola di Gorgo a Cerbara" (Rels. 6, 7, 8) (all the relevés refer to Suppl. material 1: table S14).
Phytosociological table: Suppl. material 1: table S14; taxonomic nomenclature for vascular species in accordance with Portal to the Flora of Italy (2024), for bryophytes with Aleffi et al. (2023).
Notes: The distribution of this habitat at the regional level is generally poorly understood and primarily concentrated in the southern part of the region, where it is relatively widespread within the Natura 2000 network, with reports in 11 sites (IT5320003 - Gola di Frasassi; IT5320004 - Gola della Rossa; IT5330002 - Val di Fibbia - Valle dell'Acquasanta; IT5330004 - Monte Bove; IT5330009 - Monte Giuoco del Pallone - Monte Cafaggio; IT5330016 - Gola di S. Eustachio; IT5330017 - Gola del Fiastrone; IT5340004 - Montagna dei Fiori; IT5340018 - Fiume Tronto tra Favalanciata e Acquasanta; IT5340019 - Valle dell'Ambro; IT5340020 - Valle dell'Infernaccio - Monte Sibilla), all located in the central-southern section of the Apennine chain. However, further studies are needed to obtain a more detailed mapping of the habitat's distribution. These records represent the first sightings of the habitat for the Natura 2000 sites IT5310019 - Monte Catria, Monte Acuto, and IT5310017 - Monte Nerone - Gola di Gorgo a Cerbara, located within the Catria-Nerone mountain complex (Province of Pesaro and Urbino), as well as, along with those known for the Alpe della Luna (IT5310010 - Alpe della Luna - Bocca Trabaria), the only ones for the northern part of the Marche region (Suppl. mate-

rial 2: fig. S15). Notably, about one-third of the identified stations are located just a few dozen meters outside the Natura 2000 areas but are all subject to significant anthropogenic pressures. In particular, the site at Fosso di Terie has suffered substantial impacts due to unregulated tourism, which continues to grow. Unauthorized interventions on the watercourse and surrounding environments - including the construction of walls and artificial waterfalls, along with the removal of natural vegetation to expand bathing areas and improve makeshift trails - severely compromise the integrity of the habitat and threaten the characteristic species.

#137. Annex I Habitat: 91AA*Quercus *pubescens* forests (Troia A, Brunco V, Bazan G)

EUNIS Classification system: T19 - Temperate and submediterranean thermophilous deciduous forest (EEA 2021).
Biogeographical Region: Mediterranean.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Oleo oleaster-Quercetum virgilianae* Brullo 1984; *Quercion ilicis* Br.-Bl. ex Molinier 1934 em. Brullo, Di Martino et Marcenò 1977; *Quercetalia ilicis* Br.-Bl. ex Molinier 1934; *Quercetea ilicis* Br.-Bl. in Br.-Bl., Roussine et Nègre 1952 (Brullo et al. 2008; Biondi and Blasi 2015).
Geographic information: Italy, Sicilia, Ravanusa, C.da Cannamele, 147 m a.s.l., Coordinates: 37.244860°N 13.992306°E (Suppl. material S1: table S15, Rel. 1); 157 m a.s.l., Coordinates: 37.244188°N 13.993395°E (Suppl. material 1: table S15, Rel. 2).
Cell ID in the EEA reference grid: 10kmE467N158 (Suppl. material 2: fig. S16).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table S15; taxonomic nomenclature according to Portal to the Flora of Italy (2024).
Notes: The habitat comprises small forest clusters of *Quercus pubescens* s.l. situated within an agricultural matrix, nestled in narrow valleys with steep slopes on clay-marl substrates. The plant community is classified as *Oleo oleaster-Quercetum virgilianae* Brullo 1984 (Brullo et al. 2008), an association that in Sicily has a potentially discontinuous and fragmented distribution across a broad elevational range, from the coast up to 800–1000 m a.s.l. (Guarino et al. 2015). These clusters are often represented by small, relic patches, primarily confined to more rugged, inaccessible areas, as in the case under study (Suppl. material 2: fig. S17). These habitats are particularly rare in this inland cultivated part of Sicily, and their conservation is particularly important both for their role of "island forests" and stepping-stone habitats, and as a source of seeds and genetic material for measure of recovery of the natural vegetation. Unfortunately, they are still threatened not only by fires and grazing, which are the most significant factors affecting the natural vegetation of the Sicilian countryside (Bazan et al. 2019), but also by the competition of invasive alien species (e.g., Badalamenti et al. 2018).

#138. Annex I Habitat: 9540: Mediterranean pine forests with endemic Mesogean pines (Bonari G, Candini F, Terranova G)

EUNIS Classification system: T3A - Mediterranean lowland to submontane *Pinus* forest (EEA 2021).
Biogeographical Region: Mediterranean.
National Habitat Checklist of reference: Italian Interpretation Manual of the Directive 92/43/EEC Habitats (Biondi et al. 2009).
Phytosociological reference: *Genisto pilosae-Pinion pinastri* Biondi et Vagge 2015, *Quercetalia ilicis* Br.-Bl. ex Molinier 1934, *Quercetea ilicis* Br.-Bl. in Br.-Bl., Roussine et Nègre 1952 (Bonari et al. 2021; FloraVeg.EU 2024).
Geographic information: Italy, Tuscany, San Baronto (PT), 355 m a.s.l., Coordinates: 43.840448°N, 10.921740°E (Suppl. material 1: table S16, Rel. 1).
Cell ID in the EEA reference grid: 10kmE439N230 (Suppl. material 2: fig. S18).
Natura 2000 Site Code: Currently not included in any Natura 2000 Site.
Phytosociological table: Suppl. material 1: table S16; nomenclature and taxa delimitation according to FloraVeg.EU (Chytrý et al. 2024; FloraVeg.EU 2024).
Notes: *Pinus pinaster* forests of peninsular Italy reach their southeasternmost extent in Tuscany and represent a forest type of conservation interest (Bonari et al. 2021). The biogeographical region is Mediterranean, however, these forest stands are located very close to the border with the Continental region.

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Supplementary material 1

Phytosociological tables

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Supplementary material 2

Maps and photos

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